

**B.E. Part-IV (CE) 8<sup>th</sup> Semester Final Examination, 2007**  
**Sub: Hydraulic Structures–(CE-804/5)**

**Time: Three hours**

**Full Marks: 100**

(All questions carry equal marks. Two marks are reserved for neatness in each half.)

**First Half**

*Answer any three from the following*

1. An ogee spillway has the following data:

- |                          |             |  |                        |
|--------------------------|-------------|--|------------------------|
| a) River bed level:      | EL. 140.0 m | f) Design discharge:                                       | 3400 m <sup>3</sup> /s |
| b) Spillway crest level: | EL. 171.0 m | g) No. of spans:   | 10                     |
| c) FRL:                  | EL. 176.0 m | h) Width of the span:                                      | 15 m                   |
| d) MWL:                  | EL. 178.5 m | i) Pier width:   | 2.0 m                  |
| e) TBL:                  | EL. 182.0 m | j) $K_p = 0.02, K_a = 0.2, u/s$ vertical, $d/s$ slope: 1:1 |                        |

Determine i) design head, ii) discharge at FRL, iii) discharge at MWL.

H/Hd	0.4	1.0	1.4
Ch/Cd	0.9	1.0	1.06

2. a) For the spillway in Q.1 above, determine the equations of the u/s and d/s profile of the spillway and the tangent point (where  $dy/dx = 1$ ).
- b) An overflow ogee spillway with u/s face vertical is 40.0m high. At the design head of 2.5m over the spillway crest, determine i) the discharge per unit length, ii) initial and sequent depth at the toe and iii) energy loss in a hydraulic jump formed at the toe of the spillway. Neglect energy loss due to flow over the spillway face and assume  $C_d = 2.18$ .
3. A homogeneous earthen dam is having F.R.L. at 107.00m and M.W.L at 110.00m. The upstream face is covered with dumped riprap (correction factor 0.5) and the upstream slope is 0.3. Following data were collected to compute the freeboard.

Quantity	Normal Freeboard	Minimum Freeboard
Effective fetch	4.2 km	4.65 km
Wind velocity over land	110 km/hr	55 km/hr
Average depth of reservoir	52.0 m	55.0 m

Ratio of wind velocity over land to wind velocity over water

Effective fetch (km)	1	2	4	6	8	10 and above
Ratio	1.1	1.16	1.24	1.27	1.3	1.31

Take  $R/H_o$  as 1.2 and calculate the top level of the dam. Suitably assume any other data needed.

4. a) Briefly discuss about the Preliminary and Final investigations of dams sites.
- b) Derive expressions for base width of the elementary profile of a gravity dam for i) no tension condition, and ii) no sliding condition.
5. A barrage is having the following characteristics: i) Total horizontal floor length = 30m, ii) depth of u/s pile = 6m, iii) depth of d/s pile = 10m, iv) depth of intermediate pile at 15m from d/s end = 10m, v) full pondage depth = 4m. Determine the  $\phi$  values at the key points with corrections for mutual interference only.

**Second Half**

*Answer any three from the following*

6. a) A trapezoidal homogeneous earthen dam is having the following properties:  
 i) base width 100m, ii) top width 6m, iii) u/s water depth 25m, iv) freeboard 3m, v) u/s slope 30°, vi) d/s slope 30°, vii) horizontal drainage blanket of width 25m from d/s end, viii)  $K = 4 \times 10^{-6}$  m/s.  
 Locate the phreatic line inside the body of the dam determine the discharge.
- b) Redo the above problem, assuming there is no horizontal blanket. For  $\alpha = 30^\circ$ , take  $\Delta a/(a+\Delta a) = 0.36$ .
7. A 60m high gravity dam is having the following characteristics: i) top width 8m, ii) u/s face is vertical up to 40m from top, iii) the u/s inclined face is having a slope of 1(H): 10V, iv) d/s face is vertical up to 20m from top, v) d/s face is having a slope of 1(H): 1.5(V), vi) a drainage gallery at 6m from u/s end, vii) Freeboard of 3m from top. Calculate the forces and moments at the base, considering self-weight, water pressure and uplift pressure (drains operative) only.